THIRD ORDER SUSCEPTIBILITY OF PLATINUM SULFIDE SOL

by

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Third Order Susceptibility of Platinum Sulfide Sols

The optical properties of a suspension of small metal particles in a transparent medium can differ strikingly from those of the same metal in bulk form. New materials with large values of X^3, the third order nonlinear susceptibility tensor are needed. Recent trends in nonlinear optics have centered on processes involving X^3. One method of determining X^3 involves the measurement of the optical phase conjugate signal generated by the sample. Experimentally this is determined using degenerate four-wave mixing (DFWM). Pure sulfur sol was prepared by dissolving the solid sulfur in hydrazine, followed by addition of distilled water with vigorous stirring. The sulfur sol thus produced was sealed and stored in the dark.

Platinum sols were produced by reduction of platinum chloride with 1% sodium citrate. Both solutions were mixed and heated for 30 minutes at 80 °C. Finally, both the sulfur sol and platinum sol were mixed in equal parts and heated while stirring at 80 °C for approximately 15 minutes until no further color change.

UV-Visible spectra were taken of the final platinum sulfide sol. This is shown in Figure 1. The final concentration of the platinum sulfide sol was 1.64×10^{-3} M.

The phase conjugate signal intensity was measured using DFWM. The experimental arrangement used for DFWM is shown schematically

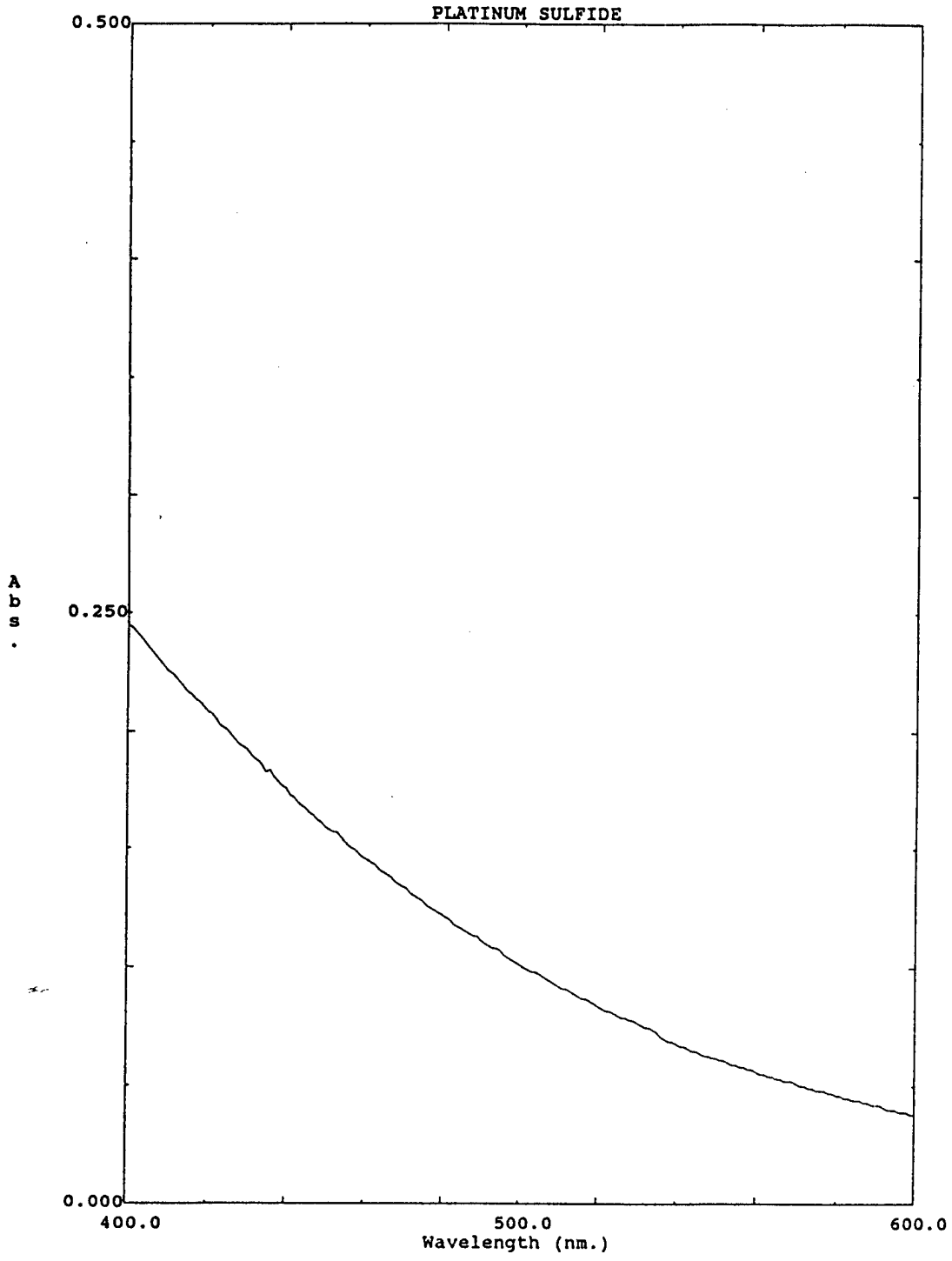
PLATINUM SULFIDE
0.500
0.250
0.000
Abs.
400.0
500.0
600.0
Wavelength (nm.)

FIGURE 1.

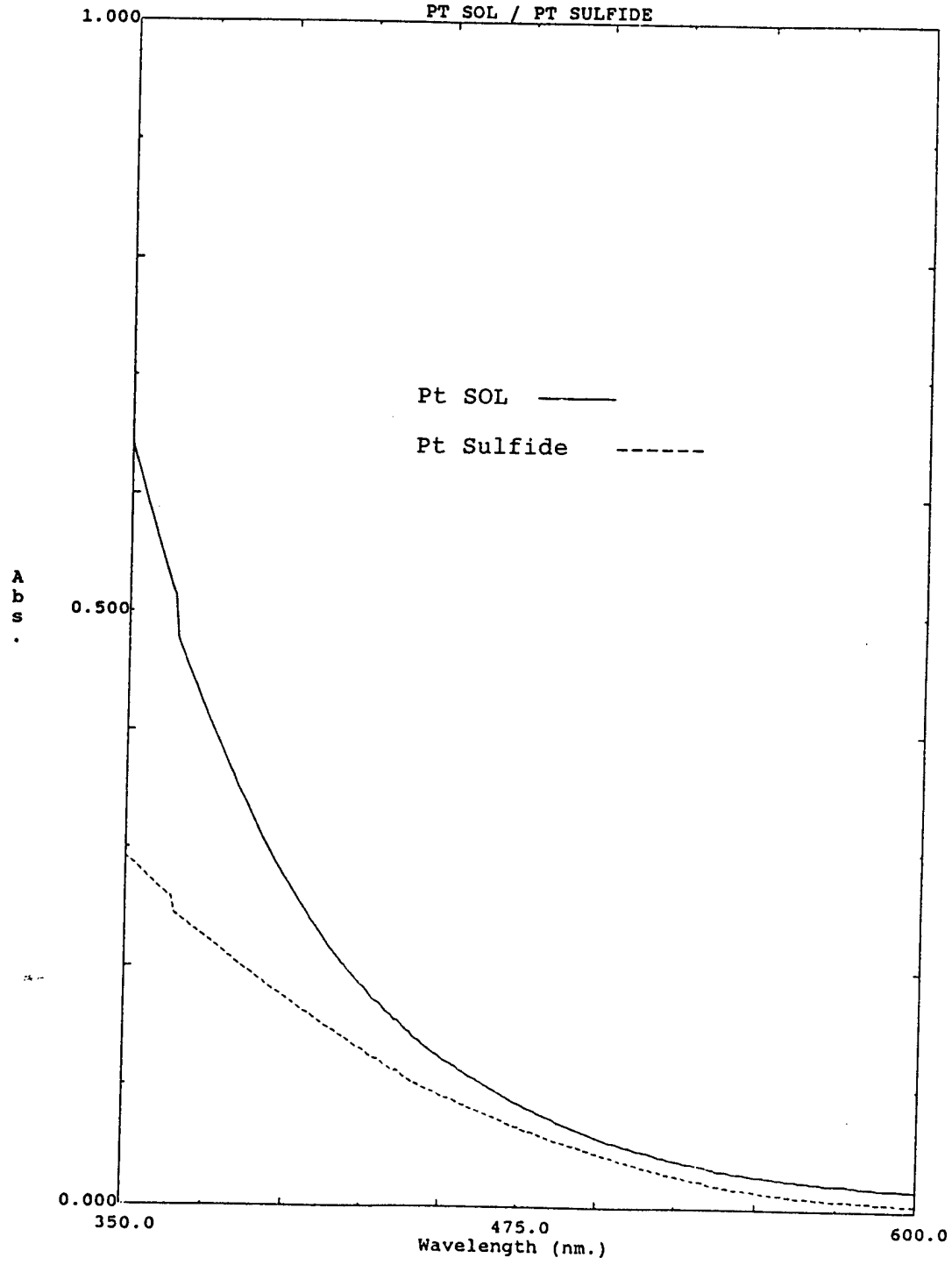
PT SOL / PT SULFIDE
1.000
0.500
0.000
Abs.
Pt SOL
Pt Sulfide
350.0
475.0
600.0
Wavelength (nm.)

FIGURE 1A.

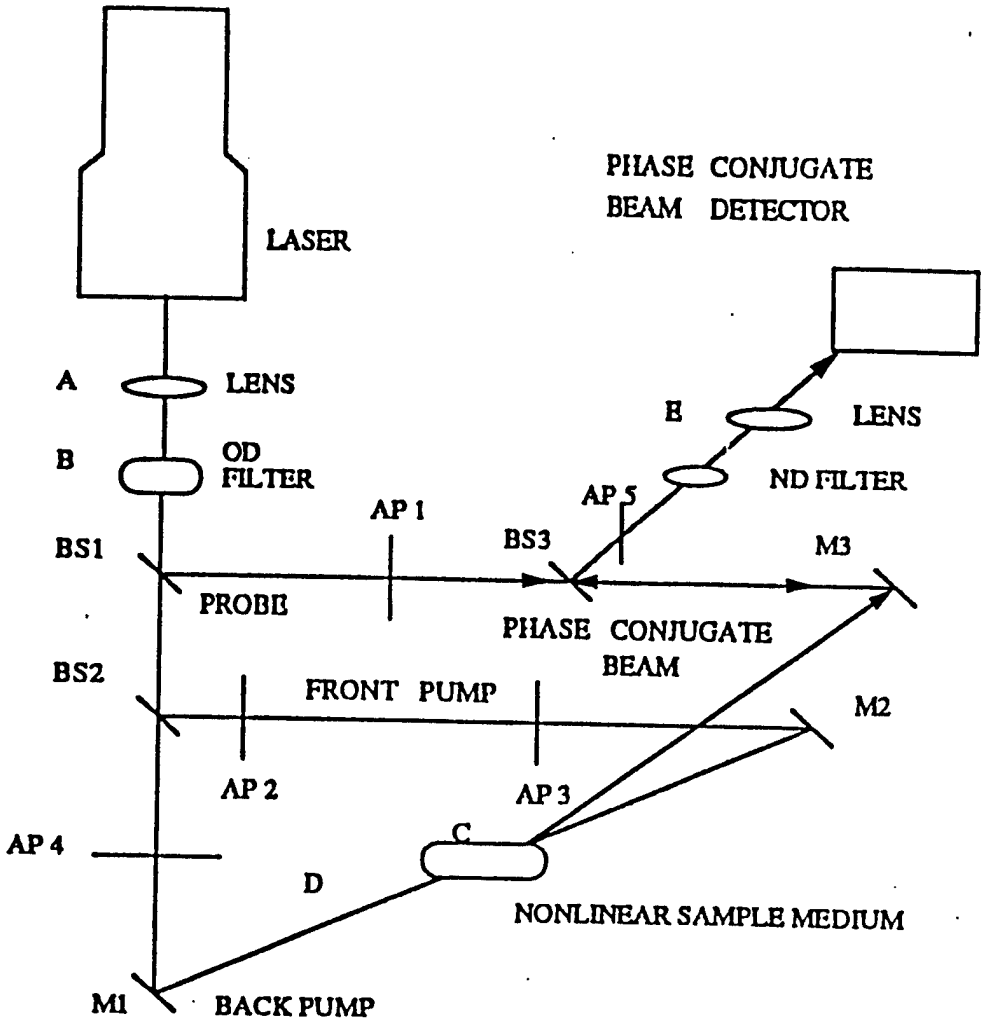

FIGURE 2. Experimental Arrangement for Degenerate Four-Wave Mixing

in Figure 2. Briefly it consisted of a lens A which focuses the beam on the sample. The optical density filter B was used to vary the intensity of all three beams. Beam splitters BS1 (5%T) and BS2 (50%T) were used to generate the probe, front pump and back pump beams respectively. All beams arrive at the sample simultaneously. The beamsplitter BS3 is used to pick off the conjugate signal which is then focused on a photodiode detector and the signal displayed on a Tektronix 2465 300MHz oscilloscope. The beam intensity was measured by another detector placed between the sample and the back pump beam and displayed on another Tektronix oscilloscope.

The intensity of the phase conjugate signal was determined from the log-log plot of the phase conjugate signal intensity versus the laser power. A similar plot was made for the reference material carbon disulfide at the same wavelength of 480nm.

The value of X^3 for platinum sulfide was 9.11×10^{-13} esu.